REMARKS

Remark 1:

Applicant hereby amends claims 3, 7 and 11 to overcome the rejections based on 35 U.S.C. 112, second paragraph, as being indefinite. Further, Applicant hereby amends claims 1, 5, and 9 to overcome the rejections based on 35 U.S.C. 103(a) as being obvious over applicant's admitted prior art and Fisher et al. and in further view of Agnes et al.

Remark 2:

Applicant hereby respectfully requests Examiner withdraw Fisher et al. and Agnes et al. as obviating prior art references under 35 U.S.C. 103(a).

Thermal shrinkage due to extremely low temperature operation and processing of cryogenic fluids through vertical cryogenic turbine generators and pumps is completely unrelated to thermal expansion of hot components in conventional, electric motors. Electric motors convert electrical energy into mechanical energy by creating a magnetic field around wound coils of metal wires while conducting electrical energy. Heat is generated in electric motors by flow of electricity and mechanical rotation of the coils. The cited prior art by Fisher et al. and Agnes et al. teach the use of spacers to increase the length of the rotating mechanical rotors for brush-type contact or electronically commutated brushless motors to compensate for *thermal expansion* of other rotating and non-rotating components.

In the instant invention, the problems are associated with *thermal shrinkage*, not expansion. In the case of a cryogenic pump, mechanical energy is added to the cryogenic fluid. In the case of the cryogenic turbine generator, mechanical energy is created by expansion of cryogenic liquid. Neither of these operations are "analog" to creating mechanical energy by conversion of electrical energy.

Moreover, the equipment and components of the present invention are not related to those found in electric motors. In electric motors, there s no analog for shaft-mounted cryogenic fluid product - lubricated type ball bearings. In electric motors, there is no analog for vertical flow of cryogenic fluid. In electric motors, the effects of thermal expansion are independent of orientation, i.e., the spacer compensates for thermal expansion of non-rotating components.

In the present invention, as described in the specification at page 4, line7, through page 5, line 17, the specific problem is associated with the operation of thrust equalizing mechanisms in vertical cryogenic fluid turbine generators and pumps. During rotation, the shaft **4** and all its rotating components move upwards due to a differential in diameter between upper wearing ring **22** and lower wearing ring **24**. Leakage flow at upper wearing ring **22** is reduced as variable orifice **20** closes, causing fluid pressure in chamber **18** to increase. The increased pressure in chamber **18** reverses the thrust which then acts in a downward direction. This causes the rotating assembly to move downward, thereby opening the variable orifice allowing the pressure in the chamber **18** to decrease. In the cited prior art related to electric motors, there is no analog structure or function for the thrust equalizing mechanism associated differential diameter set of wearing rings, variable orifice **20,** increase in pressure in fluid chamber **18** or reversal of thrust forces acting on a rotating assembly.

Finally, stationary spacer **268** of Fisher et al. and spacer **54** of Agnes et al., both of which extend the length effective of the rotor, cannot be considered analog to length compensator **26** of the present invention. Length spacer **26** of the present invention is not integral with rotating shaft **4**. Length spacer **26** of the present invention in interposed between the bearing block and stationary thrust plate **8**, thus spacing the lower bearing **6** relatively higher, closer to an upper bearing. In the cited prior art references directed to electric motors, there is no analog to reduce the span between main bearings to offset the

reduction in the critical speed resulting from an increased generator size.

Remark 3:

Applicant has filed DECLARATION OF HANS E. KIMMEL, PH.D. UNDER 37 CFR 1.132 herewith to overcome the claims rejections raised by the Examiner. Dr. Kimmel is the Executive Director and Vice President of Research and Development for the Cryodynamics Division of Ebara International Corporation and has been employed with the company in this or similar position for 17 years. Ebara International Corporation is the recognized world leader in the engineering and production of specialized cryogenic liquefied gas pumps and turbine expanders. See www. Ebaraintl.com.

Dr. Kimmel is an expert in the field of cryogenic material handling and cryogenic machinery design and manufacture. Dr. Kimmel hold a Masters Degree in the field of Mechanical and Process Engineering from the T. U. University and a Ph.D. from the F. U. U. University in Munich, Germany, and has over 40 years of professional experience. He has conducted research at numerous nationally and internationally accredited institutions of higher learning and commercial entities. He has contributed to over 50 issued patents worldwide and have published numerous papers in advanced cryogenic technology. Dr. Kimmel received recognition for my academic achievements both here in the United States as well as internationally.

Dr. Kimmel served as a member of the German Federal Board of Independent Professional Experts in the field of cryogenic rotating machinery from 1992 to 1998. In September, 2004, he testified before the Federal Bureau of Investigation (FBI) in Washington, D.C., as an independent expert in cryogenic machinery in a special case of export violation of cryogenic pumps.

Publication entitled Application of Aerospace Research on Cryogenic Fuel Technology by inventor Mr. Madison from the Aerospace Institute of Aeronautics and Astronautics conference held January 15-18, 1996 in Reno, Nevada USA is attached to Dr. Kimmel's declaration as Exhibit B. Historically, cryogenic pumps were developed from the cryogenic rocket fuel pumps utilized in aerospace engineering. As shown in Exhibit B to Dr. Kimmel's declaration, the TEM design utilized in aerospace applications was without the spacer of the present invention. Those aerospace-related rocket fuel pumps didn't have and after 30 years still don't have the TEM with spacer. Dr. Kimmel states that he does not believe that Mr. Madison's improvement with respect to submersible cryogenic generators and pumps was obvious in view of prior art related to aerospace-related rocket fuel pump technology.

Remark 4:

Dr. Kimmel states that thermal shrinkage of processing and handling equipment and components used for cryogenic fluids is an inherent problem. Handling and processing equipment is subject to thermal shrinkage based upon thermal properties, including the coefficients for thermal expansion, of the materials used in said equipment and components. Thermal shrinkage effects have overall enormous impact upon design and operation of cryogenic fluids handling and processing equipment and components. It is known, for example, that the length of a full-size cryogenic fluid tanker ship will undergo a 2-meter or more shrinkage in overall length due to decrease in temperature associated with holding cryogenic fluids. Techniques and equipment designed to operate economically and safely under these extreme cold environments have taken decades to develop.

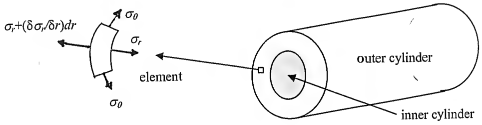
Dr. Kimmel further states that for almost 30 years, the size and speed of vertical cryogenic turbine generators and pumps was limited. As increased size had negative ramifications to the machine reliability, cryogenic turbine generators and pumps were limited by maximum "breakaway" speeds as

well as there being limitations on bearing size, shaft diameter and overall machine diameter.

Remark 5:

In Dr. Kimmel's opinion, the shrinkage of the spacer is not covered in Fisher et al. or in Agnes et al. In Agnes et al., the spacer shrinkage refers to radial shrinkage of an insulation tube item **54**. This is not the same situation as claimed in the present invention which is related to lengthwise shrinkage for a solid press fit of a spacer *in the cryogenic environment*. The claimed spacer also serves no electrical insulation function.

A detailed analysis of the present invention is useful for mathematically modeling the solution. To illustrate the shrinkage differences between the cited prior art and the present invention, consider first the case in Agnes et al., as sketched below for two concentric cylinders:

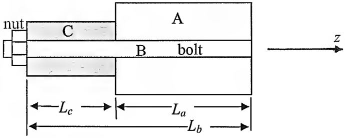


To describe the stresses in the outer element of material it is clear that

$$d\sigma_r / dr + (\sigma_r - \sigma_\theta) / r = 0$$

$d\sigma_z / dz = 0$ [Benham P., Crawford, R., & Armstrong C., (1996) Mechanics of Engineering Materials (2nd edition), Longman Scientific Publishing, ISBN: 0582251648] The last expression is important to indicate that no stress is produced in the z (cylinder axis axial) direction with the radial shrinkage of Agnes et al. insulation tube item **54**. This is due merely to the free boundary in the z direction seen in the Figure 7, item **54** of Agnes et al.

For the situation in the present invention, the spacer is bounded on its sides, and this in effect is a crucial requirement for the device to function. To illustrate, consider the sketch below which shows a spacer material C axially on top of a different material A with a 3rd material B as a bolt fastened through:



These are assembled at a warm condition, for example ambient temperature, with an axial prestress such that $d\sigma_z / dz \neq 0$. Selecting the material C so that its thermal expansion coefficient is very small (a material such as Invar) will, in effect, compensate for the thermal expansion of the other two materials A and B as the materials all get cold essentially simultaneously. This is particularly useful if A contracts axially in size more than B which could give relieve any prestress in the bolt B. Mathematically, let L_b, L_c, and L_a be the lengths of the shown bolt, compensator, and axial sleeve respectively. Also let x, y, and v be their respective thermal expansion coefficients. Thus, at a warm ambient condition:

$$L_b = L_c + L_a$$

Cooling all the materials to cryogenic temperatures gives:

$$L_b\,(x) = L_c\,(y) + L_a\,(v)$$

Thus, one can design or select the length of L_c to compensate, or preserve an axial prestress from the warm condition with the following logic:

L_b (x)= L_c (y) + L_a (v)

L_c (x) + L_a(x) = L_c (y) + L_a (v)

L_c (x) - L_c(y) = L_a (v) + L_a (x)

L_c = L_a (v-x) / (x-y), so that in the cold condition, $d\sigma_z / dz \neq 0$ due to the compensated length, preserving the axial stress provided by L_c. Hence, the bearing described in the present Application can be axially moved while still being secured in place axially, i.e., not loose. This situation is very different from the radial stress cited as prior art in the work of Agnes et al.

It is hoped that with this additional clarification, the Examiner of the US Patent Office will reconsider the pending claims rejection.

Remark 6: (NO NEW MATTER)

Applicant submits that the corrections presented herein present no new matter. All of the devices, systems, methods and/or compositions claimed herein are taught in the Drawings, Specification, Claims and Abstract and other portions of the Application as originally filed.

Remark 7: (REQUEST FOR TELEPHONIC OR IN-PERSON EXAMINER'S INTERVIEW)

Applicant hereby invites and requests the Examiner to attempt to resolve any further defects, deficiencies, errors or other grounds of rejection or objection to the present application, either on a formal or informal basis, by Telephonic or In-Person Examiner's Interview under 37 CFR 1.133 (see also MPEP 713.01 et seq.). Attorney for Applicant(s) can be reached from 9:00 AM-5:00 PM Monday-Friday at telephone number 650-348-1444 or by fax to (650) 348-8655 or by e-mail at RKS@ATTYCUBED.COM.

CONCLUSION

Applicant respectfully submits that for all the foregoing reasons, the claimed subject matter describes patentable invention. Furthermore, Applicant submits that the specification is adequate and that the claims are now in a condition for allowance. No new matter has been entered.

Applicant hereby respectfully requests Examiner to withdraw the cited references as anticipating or obviating prior art, enter these amendments, find them descriptive of useful, novel and non-obvious subject matter, and authorize the issuance of a utility patent for the truly meritorious, deserving invention disclosed and claimed herein.

Without further, Applicant does not intend to waive any claims, arguments or defenses that they may have in response to any official or informal communication, paper, office action, or otherwise, and they expressly reserve the right to assert any traverse, additional grounds establishing specificity and clarity, enablement, novelty, uniqueness, non-obviousness, or other patentability, etc.

Further, nothing herein shall be construed as establishing the basis for any prosecution history or file wrapper estoppel, or similar in order to limit or bar any claim of infringement of the invention, either directly or under the Doctrine of Equivalents.

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Respectfully submitted,

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Dated: March 30, 2009

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CERTIFICATE OF TRANSMISSION

I hereby certify that this paper and the documents referred to as attached therein are being filed using USPTO TEAS service under 37 CFR 1.10 on the date indicated and is addressed to "Commissioner for Trademarks. Signed: /Leo K. Lai/ .
Date Mailed: March 30, 2009